

**REDUCE OPEX AND CAPEX IN REFINING PROCESS UNIT FIRED HEATERS
USING CERAMIC COATING TECHNOLOGY**

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ABSTRACT

Ceramic coating “A” is a unique disruptive technology for refining, chemical, and petrochemical critical applications, a game-changer for the industry to reduce OPEX and CAPEX. This Innovative and customized silica-based inert coating technology provides anti-fouling, anti-corrosion, and anti-coking properties for the harsh environments and extreme temperatures (700°C/1300°F) applications, making the ceramic coating “A” useful in almost all refineries and petrochemical applications, focusing on delayed cokers, visbreakers, cracking, vacuum distillation unit furnaces and similar units.

In most refining conversion units such as delayed coker and others, unscheduled shutdowns, high maintenance, higher fuel consumption, and throughput reduction due to furnace tube coking, fouling and corrosion is widespread problem. Ceramic coating technology minimizes formation, deposition, and plugging due to coke/carbon in addition to the reduction in fouling, corrosion, and fuel usage. The use of the ceramic coating technology in these applications leads to longer runs, the incremental life cycle for equipment, reliable operations, reduced fuel consumptions, and hence significant savings in OPEX and CAPEX.

This presentation covers the properties and advantages of resistance of ceramic coated tubes to various forms of coking, corrosion, fouling, scaling, and the expected cost savings. Results and case studies from various commercial field trials and runs with major US, European, and Asian refineries and further developments and new applications are also covered in this presentation.

Keywords: anti-coking, ceramic coating, stainless steel,

INTRODUCTION

The formation of carbon deposits and fouling of tubes is one of the most common operational issues regarding the operability and lifetime of materials at an industrial scale. Several billion dollars are spent worldwide on annual basis to upgrade/change materials apart from revenue loss on account of production halt and additional costs incurred in maintenances. Particularly, the carbon deposition in the refining process is an evitable and undesired factor. Most refineries worldwide have vacuum distillation, delayed cokers, visbreakers, or thermal cracking units where coke formation occurs faster due to high temperatures used in the process. Therefore, unscheduled shutdowns are required, or throughput is reduced due to tube de-coking. From an economic point of view, stainless steel is the most frequently used material, but sometimes more expensive metals are required. The coating of the internal surface with a ceramic layer is useful for preventing the formation of deposits and extending the lifetime of the tubes. This innovative solution not only helps fight fouling, erosion, and corrosion but also helps in an overall reduction of cost, reliable plant operations with improved energy efficiency.

In this sense, a thin layer of the innovative ceramic coating “A” is proposed, which reduces the deposition of this carbon (fouling) and allows operating at severe conditions with a better thermal transfer, thus avoiding the need for more expensive materials and significant costs on maintenance operations. This advanced ceramic coating is a unique disruptive technology for refining, chemical, and petrochemical applications, which is bound to be a game-changer for the industry. This proprietary technology has been developed by a premium advanced tubular solutions manufacturer over the past 10 years with significant investment and R&D resources. Its exclusive production process applies a thin layer (Avg 0.20 mm) of the ceramic coating to the inner or outer surface of tubular products (pipes, tubes, and fittings made from different substrates, such as carbon steel, stainless steel, and metal alloys), to improve their properties. It has excellent resistance to coking, erosion, and corrosion at extreme conditions and high temperatures up to 800°C (1472°F) in critical refinery and petrochemical process equipment. Ceramic coated tubes also minimize coke formation, deposition, and plugging due to their chemical inertness in delayed coker, visbraker, vacuum distillation unit, resid hydrocracker, and other refinery unit furnaces. These benefits improve unit run lengths, unit reliability, heat transfer efficiency, and tubes life cycle without the same level of need for decoking, and they increase throughput and reduce the carbon footprint for both new and aging plant equipment.

Dimension range and coating procedure

Ceramic coating “A” is factory applied on the internal or external surface of tubes and fittings. It can be supplied for a dimension range from $\frac{3}{4}$ ” up to 10” OD. Fittings such as return bends, reducers, elbows, and flanges can also be coated.

Regarding the coating procedure, the following steps are followed: Firstly, the base material is inspected to verify that meets all specific project requirements. Secondly, the surface is sandblasted to remove any contaminant and increase tube roughness for optimum coating application. After this, the coating is applied on the steel surface using advanced techniques that provide homogeneous thickness along the tube length. Finally, tubes are thermal treated which provides glass properties to the coating and enhances adherence between coating and base material.

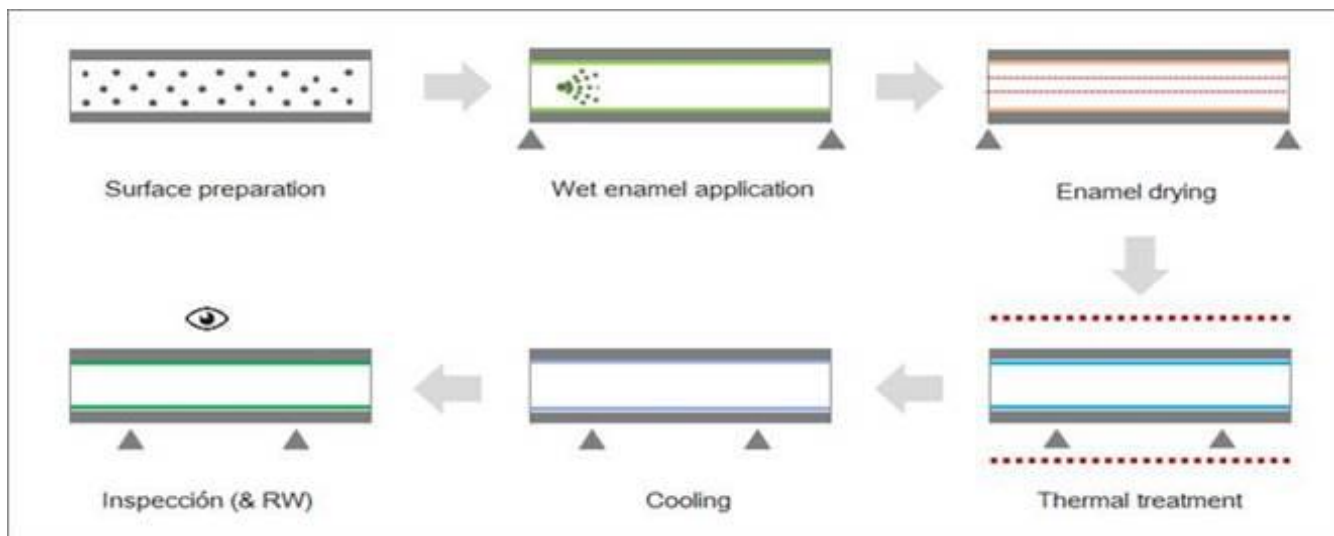


Figure 1. Coating procedure.

Quality inspection

Coated tubes are inspected to verify optimum thickness, roughness, and porosity. Visual inspection is performed through the whole length using a boroscope when the coating is on the internal surface. Roughness is measured in both tube ends, and it is controlled that all dosing parameters remain constant during the process. Porosity is measured by a holiday detector through the whole length, by means of isolated lances coupled to detectors and moved along the inner side of the tubes. Magnetic Induction Method is used to measure ceramic coating thickness on carbon steel tubes, whereas Eddy Current Method is used for measurements on stainless steel tubes.

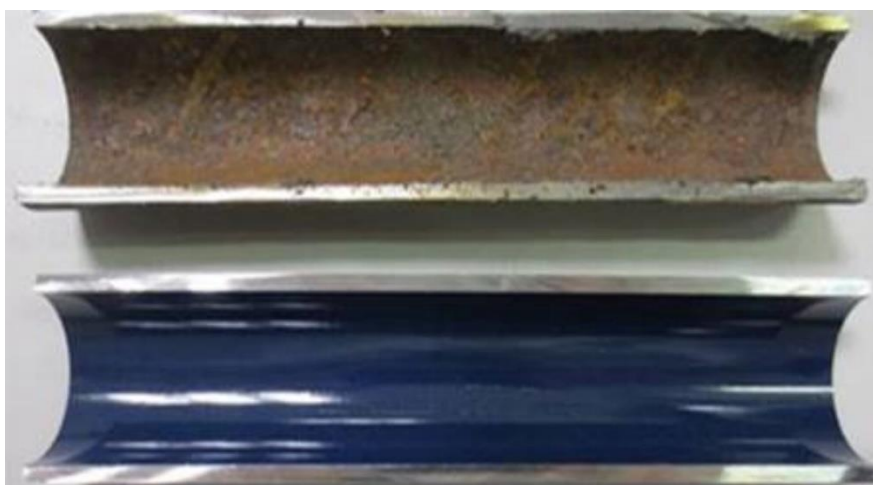


Figure 2. Uncoated Vs. Coated Tube:
uncoated vs. coated tube after one year in refinery process service.

Key properties

The coating is a continuous, homogeneous layer. This premium advanced solutions manufacturer can control the thickness of the layer across the pipe in a unique way, based on suspension parameters and rheological properties. There is a 97% drop in roughness from the uncoated to the coated tube, minimizing particle adhesion. As we know, the smoother the surface, the less resistance there is to the